Installation, Startup, and Operating Instructions

Oil-Fired
Cast Iron Hot Water Boilers
Sizes 140,000 through 280,000

BW4B
BW5B

NOTE: Read the entire instruction manual before starting the installation.

This symbol → indicates a change since the last issue.

TABLE OF CONTENTS

SAFETY CONSIDERATIONS....2
INTRODUCTION....4
- Explanation of Model Numbers and Rating Plate....4
- General Information....4

LOCATION....4
- Before You Start....4
- Locating the Boiler....5

INSTALLATION....6
- Installation Requirements....6
- Fresh Air for Combustion....6
  - Boiler Located in Unconfined Space....6
  - Boiler Located in Confined Space....6
- Boilers With Tankless Heater Coil....7
  - Mounting Aquastat Control....8
  - Tankless Coil Piping....8
- Installation System Piping....8
- Chimney and Chimney Connection....9
  - Checking Chimney....9
  - Chimney Connector and Draft Regulator....11
  - Minimum Vent Pipe Clearance....11
- Electrical Wiring....11
  - Installing Thermostat (Not Provided)....11
  - Grounding....11
  - Electrcial Power Supply....11
  - Connecting 115–V Electrical Wiring to Boiler....12
  - Thermostat Connections....12
  - Thermostat Heat Anticipator Adjustment....12
- Equipment and Optional Accessories....12
  - Relief Valve (Required, Provided)....12
  - Expansion Tank (Not Provided)....12
  - Diaphragm-Type Expansion Tank (Not Provided)....13
  - Air Eliminating Fitting (Air Purger) (Not Provided)....13
  - Main Air Vent for Downflow Systems or Diaphragm-Type Expansion Tank (Not Provided)....13
  - Aquastat Relay Control (Provided)....14
  - Automatic Fill Valve (Not Provided)....14
  - Drain Valve (Provided)....14
  - Circulating Pump (Provided)....14
  - → Oil Solenoid Valve....14
- Filling Boiler....14
  - How a Hot Water System Operates....14
  - Filling System With Water....14

OPERATING BOILER....14
- To Start....15
- Fuel Units and Oil Lines....15
- Air Supply for Combustion....15
- Draft Regulators (Provided)....15
- Nozzles (Provided)....15
- Final Burner Adjustments....15

Form: IM-BW4B-02 Cancels: IM-BW4B-01 Printed in U.S.A. 8-02 Catalog No. 63BW-4B1

Oil Burner Maintenance 15
Oil Burner Motor 15
Fuel Filter 15
Fuel Pump Unit 15
Ignition Electrodes 15
Nozzle 15
Fan and Blower Housing 15
Checking and Adjusting Controls 15
Adjusting Operating Controls 16
Checking Thermostat Operation 17
MAINTENANCE 17
Relief Valve 17
Conventional Expansion Tank 17
Diaphragm Expansion Tank 17
Water System 17
Tankless Coil (Or Cover Plate) Gasket 17
Oil Boiler/Burner Cleaning Instructions 17
Sequence of Operation- 18
Boiler with Tankless Coil 18
Boiler Without Tankless Coil 19
Service Hints 19
Parts List 20

SAFETY CONSIDERATIONS

ASME

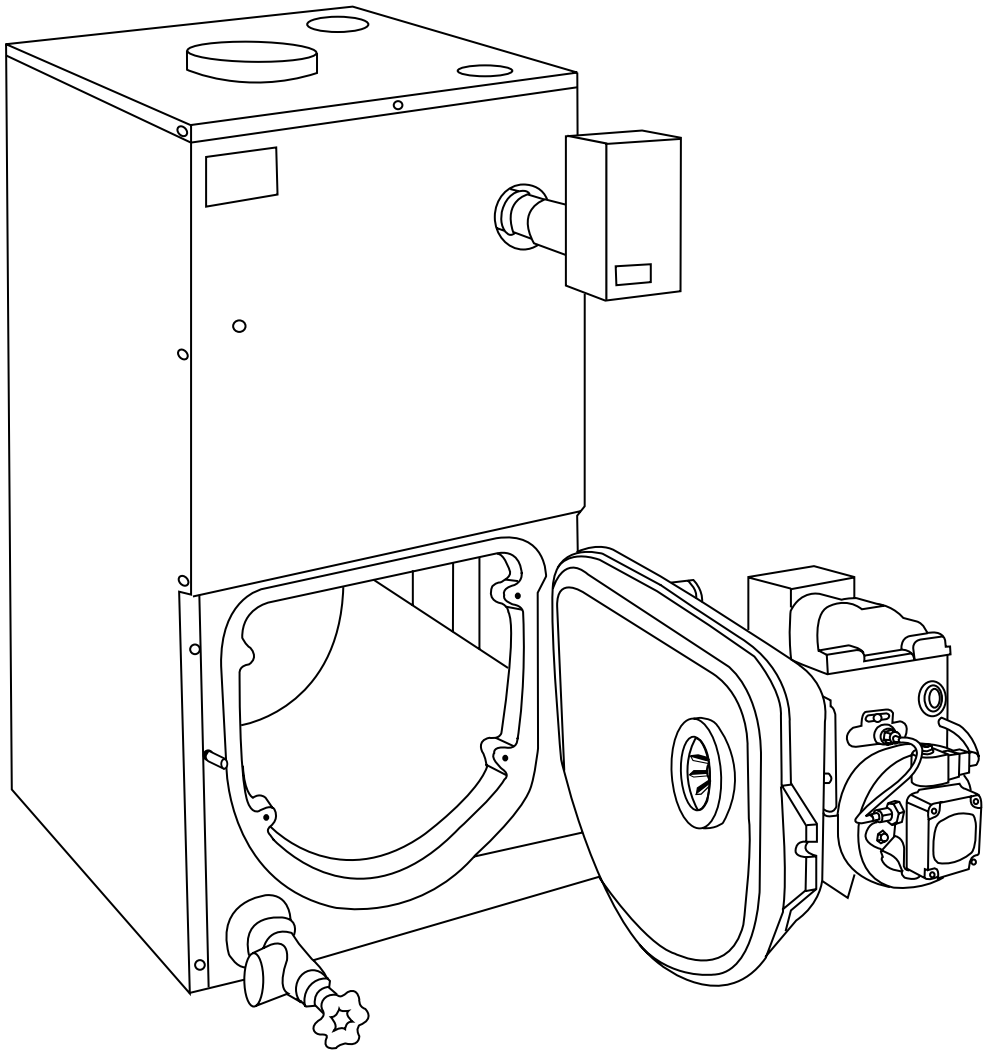
Installing and servicing heating equipment can be hazardous due to oil and electrical components. Only trained and qualified personnel should install, repair, or service heating equipment. Untrained personnel can perform basic maintenance functions such as maintaining water level. All other operations must be performed by trained service personnel. When working on heating equipment, observe precautions in literature, on tags, and on labels attached to or shipped with unit and other safety precautions that may apply.

Recognize safety information. This is the safety-alert symbol ⚠ . When you see this symbol on unit or in instructions and manuals, be alert to potential for personal injury.

Understand the signal words DANGER, WARNING, CAUTION, and NOTE. These words are used with the safety-alert symbol. DANGER identifies the most serious hazards which **will** result in severe personal injury or death. WARNING signifies hazards which **could** result in personal injury or death. CAUTION is used to identify unsafe practices which **would** result in minor personal injury or product and property damage. NOTE is used to highlight suggestions which will result in enhanced installation, reliability, or operation.

Read and obey the following rules to ensure safe installation and operation:

1. Read the Owner's Manual carefully for safe operation. Failure to follow the rules of safe operation and the instructions can cause a malfunction of the boiler and result in death, serious bodily injury, and/or property damage.
2. Check local codes and utility requirements before installation. The installation must be in accordance with their directives, or follow NFPA 31—Installation of Oil Burning Equipment, latest revision.
3. Before servicing, allow boiler to cool. Always shut off any electricity and oil to boiler when working on it. This prevents any electrical shocks or burns.
4. Inspect oil line and connections for leaks.
5. Be certain oil burner nozzle is size required. Overfiring will result in early failure of boiler sections. This causes dangerous operation.
6. Never vent this boiler into an enclosed space. Always vent to the outside. Never vent to another room or inside a building.



A02217

→ **Fig. 1—Model BW4B/BW5B**

7. Be sure there is adequate air supply for complete combustion.
8. Follow a regular service and maintenance schedule for efficient and safe operation.
9. Keep boiler area clean and free from combustible materials, gasoline, and other flammable vapors and liquids.
10. Oil Burners are not do-it yourself items. This boiler must be installed and serviced by qualified professionals using combustion test instruments.
11. Be aware when piping the relief valve that if the system pressure exceeds the safe limit of 30 pounds per square inch, the relief valve will automatically lift open. Lifting of the relief valve can discharge large quantities of steam and hot water, which may damage the surroundings. Before installing the relief valve read the manufacturer's instructions and maintenance section of the manual on relief valves.
12. Installation and sizing of the expansion tank must consider the heating systems total water volume, temperature, boiler initial fill pressure, and system arrangement. An improperly installed and sized expansion tank may result in frequent lifting of the relief valve or other heating system problems. For proper installation, sizing, and maintenance of the expansion tank follow the guidelines established by the boiler manufacturer and the expansion tank manufacturer.
13. Expansion tank performance and life expectancy can be hindered by overfilling the boiler. An initial fill pressure of 10–12 psig is recommended. For higher fill pressures the expansion tank's air charge will need to be increased to match the fill pressure. Consult the manufacturer's guidelines for sizing and selection.

14. Purging the heating system of air and gases when first putting the boiler into service is critical for proper circulation and quiet performance. Once the air and gases are purged, for boiler installations using float type vents, the air vents should be closed for normal operation. If air is heard or noticed by loss of heat, purge the system and open the vents for a short period of time.

⚠ WARNING: Use only number 1 or number 2 fuel oil having commercial standard grade CS 12-48. Do not use gasoline, kerosene, crankcase oil, or any oil containing gasoline. A failure to adhere to this warning can cause a fire, explosion, physical injury, or death.

⚠ WARNING: This boiler has been designed for residential installations. If used for commercial applications, all jurisdictional requirements must be met. This may require wiring and/or piping modifications. The manufacturer is not responsible for any changes to original design.

⚠ WARNING: DO NOT USE GASOLINE CRANKCASE DRAININGS OR ANY OIL CONTAINING GASOLINE.

INTRODUCTION

Check to be sure boiler size is correct before starting installation. See rating and capacity table shown in Fig. 2 and Table 1a and 1b. Check rating plate on right side of boiler.

The boiler must be supplied with the proper oil, fresh air for combustion, and a suitable electrical supply. Boiler must also be connected to a suitable venting system and an adequate piping system. Finally, a properly located thermostat is needed for control of heating system. If there are any doubts as to the various requirements, check with local authorities and obtain professional help where needed. The Operating Boiler Instructions and Final Checks and Adjustments sections later in this document are vital to the proper and safe operation of the heating system. Take time to be sure they are all done.

The following steps are all necessary for proper installation and safe operation of boiler:

1. LOCATING THE BOILER
2. OIL SUPPLY AND PIPING
3. FRESH AIR FOR COMBUSTION
4. PIPING CONNECTIONS
5. CHIMNEY AND VENT PIPE CONNECTIONS
6. ELECTRICAL WIRING
7. THERMOSTAT LOCATION
8. CHECKING AND ADJUSTING
9. MAINTENANCE

⚠ WARNING: Improper installation, adjustment, alteration, service, maintenance, or use can cause carbon monoxide poisoning, explosion, fire, electrical shock, or other conditions which may cause personal injury or property damage. Consult a qualified installer, service agency, fuel oil supplier, or your distributor or branch for information or assistance. The qualified installer or agency must use only factory-authorized and listed kits or accessories when modifying this product. Failure to follow this warning could result in electrical shock, fire, personal injury, or death.

PROCEDURE 1—EXPLANATION OF MODEL NUMBERS AND RATING PLATE

Each model number has 3 possible firing rates depending on which nozzle is installed. The model number represents the largest possible input for the unit. For example, a BW4BAH000140ABAA has a maximum input of 140,000 Btuh. The rating plate for each model shows the three possible firing rates. Boilers come shipped with the largest nozzle installed. By changing nozzles, the BW4BAH000140ABAA firing rate can be changed to 91,000 or 105,000 Btuh input.

→ The BW4(5)BAH000280ABAA is shipped with 2 additional nozzles to fire the boiler at the alternate inputs listed on the rating plate. The BW4(5)BAH000210ABAA and BW4(5)BAH000140ABAA are shipped with one additional nozzle each, to fire the boilers at the next lowest inputs listed on the rating plate. To fire the BW4(5)BAH000210ABAA and BW4(5)BAH000140ABAA at the lowest inputs listed on the rating plate, an accessory low-fire kit for each boiler, not included with the boiler, is required. The low-fire kits include the alternate size nozzle and alternate burner end cone to fire these boilers at the lowest inputs for those models. Refer to Tables 1a, 1b, and Table 7 for additional oil burner information. Refer to the boiler product data sheet for the correct low-fire kit.

PROCEDURE 2—GENERAL INFORMATION

Boilers with the same number of sections are identical to each other except for their firing rate. The firing rate is determined by the nozzle size in the oil burner and the oil pressure at the nozzle. For example, models BW4BAH091, BW4BAH105, and BW4BAH140 are the same boiler, without a tankless coil, except for the firing rate of the oil burner. Models BW5BAH126, BW5BAH175 and BW4BAH210 are the same boiler, with a tankless coil, except for the firing rate of the oil burner.

LOCATION

PROCEDURE 1—BEFORE YOU START

Complete all of the following prior to installing the boiler:

→ **Table 1a—Boiler Ratings and Capacities**

	NO. SEC	INPUT *MBH	**HEATING CAPACITY *MBH	NET I=B=R RATING *MBH	FIRING RATE +GPH	++A.F.U.E.	MIN. CHIMNEY SIZE/HEIGHT	DIMENSIONS-IN.			SHIPPING WEIGHT	TANKLESS HEATER G.P.M.##
Without Tankless Coil								A	B	C		
BW4BAH140	3	91	80	70	0.65	#86.3	8” X 8” X 15’	14 1/2	6	8	460	N/A
	3	105	92	80	0.75	#85.2	8” X 8” X 15’	14 1/2	6	8	460	N/A
	3	140	119	103	1.00	83.4	8” X 8” X 15’	14 1/2	6	8	460	N/A
BW4BAH210	4	126	111	97	0.90	#86.0	8” X 8” X 15’	17 3/4	6	9 5/8	533	N/A
	4	175	150	130	1.25	83.9	8” X 8” X 15’	17 3/4	6	9 5/8	533	N/A
	4	210	178	155	1.50	82.4	8” X 8” X 15’	17 3/4	6	9 5/8	533	N/A
BW4BAH280	5	168	147	128	1.20	#86.5	8” X 8” X 15’	21	6	11 1/2	620	N/A
	5	245	209	182	1.75	83.6	8” X 8” X 15’	21	6	11 1/2	620	N/A
	5	280	236	205	2.00	82.0	8” X 8” X 20’	21	6	11 1/2	620	N/A

Shaded areas are as shipped. Alternate inputs require a field-installed alternate oil nozzle supplied with base model, or Accessory Low Fire Kit required for 91,000 and 126,000 MBH inputs.
* MBH = 1,000 BTU per hour/BTU=British Thermal Unit
** Heating Capacity is based on a 13 percent CO_2 with a -0.02 in. wc draft over fire and a #1 smoke or less. Testing was done in accordance with the D.O.E. (Department of Energy) test procedure.
+ GPH = Gallons per hour of oil at 140,000 BTU per gallon
++ A.F.U.E. = Annual Fuel Utilization Efficiency based upon D.O.E. test procedure
# As an Energy Star Partner, the manufacturer has determined that this product meets Energy Star guidelines for Energy Efficiency
# # Gallons of water per minute, heated from 40°F to 140°F, with 200°F boiler water temperature, intermittent draw.

→ **Table 1b—Boiler Ratings and Capacities**

	NO. SEC	INPUT *MBH	**HEATING CAPACITY *MBH	NET I=B=R RATING *MBH	FIRING RATE +GPH	++A.F.U.E.	MIN. CHIMNEY SIZE/HEIGHT	DIMENSIONS-IN.			SHIPPING WEIGHT	TANKLESS HEATER G.P.M.##
With Tankless Coil								A	B	C		
BW5BAH140	3	91	80	70	0.65	#86.3	8” X 8” X 15’	14 1/2	6	8	470	2.90
	3	105	92	80	0.75	#85.2	8” X 8” X 15’	14 1/2	6	8	470	3.00
	3	140	119	103	1.00	83.4	8” X 8” X 15’	14 1/2	6	8	470	3.25
BW5BAH210	4	126	111	97	0.90	#86.0	8” X 8” X 15’	17 3/4	6	9 5/8	545	3.15
	4	175	150	130	1.25	83.9	8” X 8” X 15’	17 3/4	6	9 5/8	545	3.50
	4	210	178	155	1.50	82.4	8” X 8” X 15’	17 3/4	6	9 5/8	545	3.75
BW5BAH280	5	168	147	128	1.20	#86.5	8” X 8” X 15’	21	6	11 1/2	630	3.45
	5	245	209	182	1.75	83.6	8” X 8” X 15’	21	6	11 1/2	630	4.00
	5	280	236	205	2.00	82.0	8” X 8” X 20’	21	6	11 1/2	630	4.25

Shaded areas are as shipped. Alternate inputs require a field-installed alternate oil nozzle supplied with base model, or Accessory Low Fire Kit required for 91,000 and 126,000 MBH inputs.
* MBH = 1,000 BTU per hour/BTU=British Thermal Unit
** Heating Capacity is based on a 13 percent CO_2 with a -0.02 in. wc draft over fire and a #1 smoke or less. Testing was done in accordance with the D.O.E. (Department of Energy) test procedure.
+ GPH = Gallons per hour of oil at 140,000 BTU per gallon
++ A.F.U.E. = Annual Fuel Utilization Efficiency based upon D.O.E. test procedure
# As an Energy Star Partner, the manufacturer has determined that this product meets Energy Star guidelines for Energy Efficiency
# # Gallons of water per minute, heated from 40°F to 140°F, with 200°F boiler water temperature, intermittent draw.

1. Check to be sure you have selected the right size boiler with the proper capacity. The I=B=R rating of the boiler selected should be greater than or equal to the calculated peak heating load (heat loss) for the building or area(s) served by the boiler and associated hot water heating systems. (See Fig. 2.) Any heat loss calculations used should be based on approved methods.
2. Boiler must be supplied with the proper oil supply and oil piping, sufficient fresh combustion air, and a suitable electrical supply.
3. Boiler must be connected to a suitable venting system and a piping system adequate to distribute the heating load.
4. A thermostat must be properly located and installed for control of the heating system.

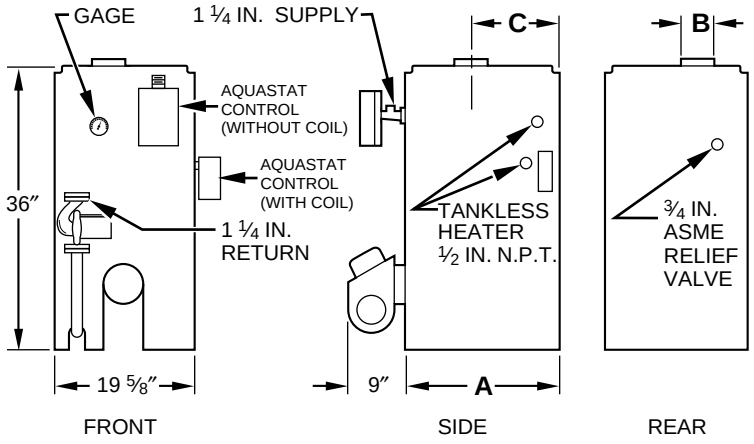
If there are any doubts as to the various requirements, check with local authorities and obtain professional help where needed. The Operation Instructions, Final Checks and Adjustments and Maintenance sections in this manual are vital to the proper and safe operation of the heating system. Take the time to be sure they are all done.

PROCEDURE 2—LOCATING THE BOILER

If boiler is part of a planned heating system, locate it as close as possible to where it is shown on plan. If boiler is to be part of an existing system, it is usually best to put it where the old one was. If location is to be changed, additional materials as well as an adequate base will be required.

The following rules apply:

1. The boiler must be level.
2. Use a raised base if floor can become wet or damp.
3. These boilers must have a non-combustible base if installed on a combustible floor. Two inch concrete patio blocks or a 2-in. Cladlite™ pad may be used.



A96152

Fig. 2—Dimensional Drawing

4. The vent pipe connection should be as short as possible.
5. Maintain clearances for fire safety as well as servicing. Refer to Fig. 3 for minimum clearances. An 18-in. clearance must be maintained at a side where passage is required to access another side for cleaning, servicing, inspection, or replacement of any parts that normally may require such attention. Boilers must be installed at least 6-in. from combustible materials on all sides and above. Allow at least 24-in. front clearance for servicing. Allow at least 18-in. right-side clearance for servicing boilers equipped with a tankless coil.
6. Fresh air for combustion must be available at front of boiler. Fresh air for ventilation must be available to front AND rear of boiler. Air passages must be free of obstructions at all times. Ventilating and combustion air must enter boiler room without restrictions.
7. Be sure installation is in accordance with the requirements of local authorities having jurisdiction. Compliance with these regulations is required. In the absence of local codes, follow NFPA 31—Installation of Oil Burning Equipment.

INSTALLATION

PROCEDURE 1—INSTALLATION REQUIREMENTS

Refer to Fig. 4 for the basic requirements of a typical installation.

NOTE: Always keep manual fuel supply valve shut off if burner is shut down for an extended period of time.

PROCEDURE 2—FRESH AIR FOR COMBUSTION

⚠ WARNING: Be sure to provide enough fresh air for combustion. Enough air ensures proper combustion and ASSURES THAT NO HAZARD WILL DEVELOP DUE TO LACK OF OXYGEN. Failure to follow this warning can cause a fire, personal injury, or death.

⚠ CAUTION: Air for combustion must not be contaminated by halogen compounds, which include fluoride, chloride, bromide, and iodide. These elements are found in aerosol sprays, detergents, bleaches, cleaning solvents, salts, air fresheners, and other household products. Excessive exposure to contaminated combustion air will result in safety and performance related problems.

⚠ CAUTION: If a fireplace or a kitchen or bathroom exhaust fan is used, an outside air intake should be installed. These devices rob the boiler and water heater of combustion air.

Enough fresh air must be provided to assure proper combustion. The fire in the boiler uses oxygen. It must have a continuous supply. The air in a house contains only enough oxygen to supply the burner for a short time. Outside air must enter the house to replace that used by the burner. The exact fresh air requirements depend on whether the boiler is located in an unconfined or confined space.

A. Boiler Located in Unconfined Space

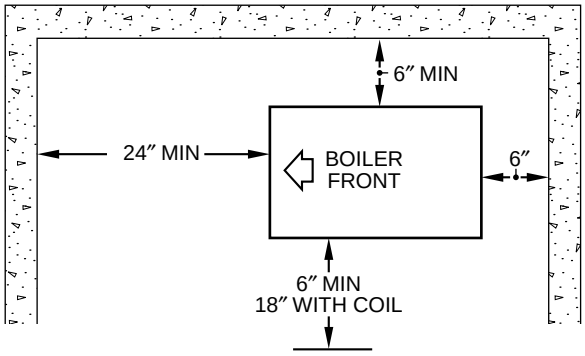
An unconfined space is defined as a space with volume not less than 50 cu ft per 1000 Btuh of total input rating of all appliances installed in that space.

If boiler is in an open area (unpartitioned basement) in a conventional house, air that leaks through cracks around doors and windows will usually be adequate to provide air for combustion. The doors should not fit tightly. Cracks around windows should not be caulked.

B. Boiler Located in Confined Space

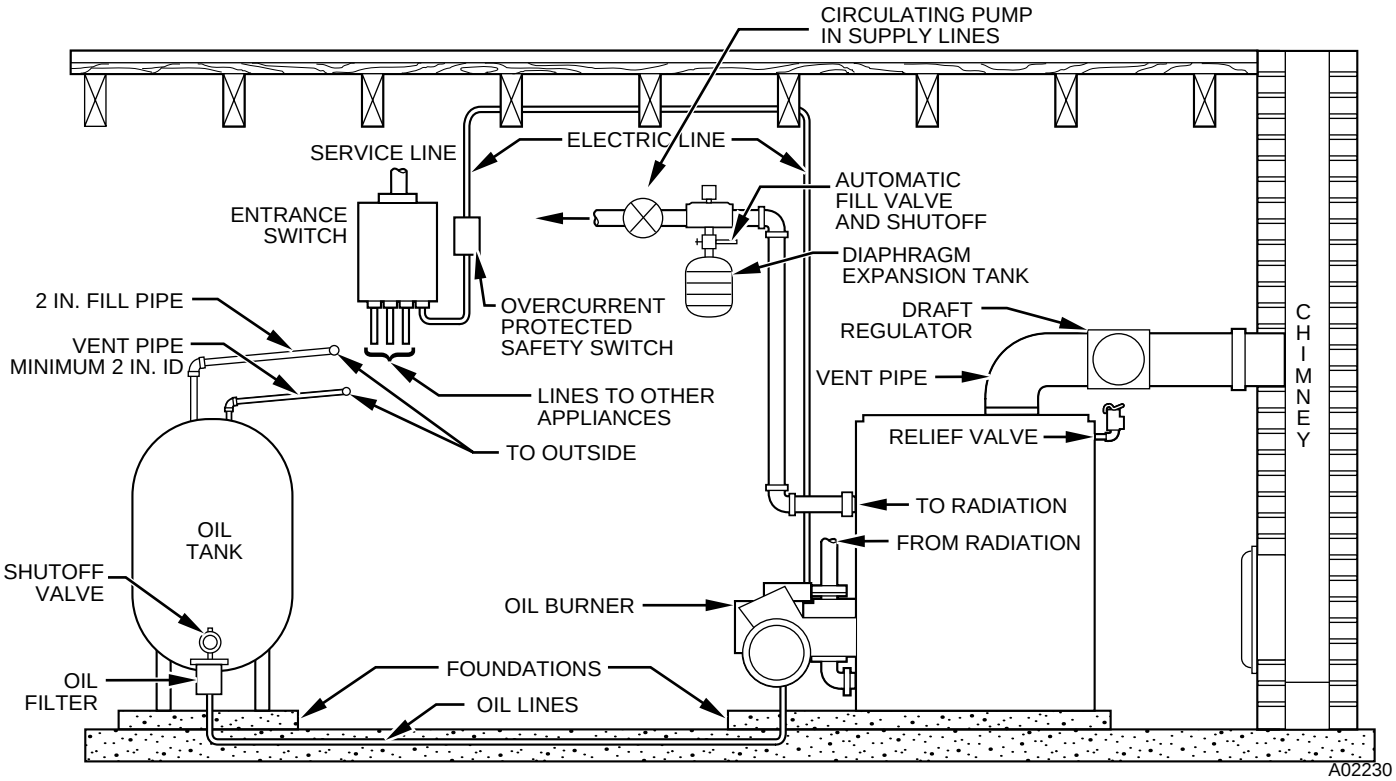
ALL AIR FROM INSIDE BUILDING

The confined space shall be provided with 2 permanent openings communicating directly with an additional room(s) of sufficient volume so that the combined volume of all spaces meets the criteria for an unconfined space. The total input of all combustion equipment installed in the combined space shall be considered in making this determination. Each opening shall have a minimum free area of 1 sq in. per 1000 Btuh of total input rating for all combustion equipment in the confined space, but not less than 100 sq in. One opening shall be within 12 in. of the top and 1 within 12 in. of the bottom of the enclosure. (See Fig. 5.)



A95592

Fig. 3—Minimum Clearance Dimensions



A02230

→ **Fig. 4—General Principal Requirements for a Typical Installation**

Example: The boiler is rated at 100,000 Btuh. The water heater is rated at 30,000 Btuh. The total is 130,000 Btuh. Two grilles are needed, each with 130 sq in. of FREE opening. Metal grilles have about 60 percent FREE area. To find the louvered area needed, multiply the FREE area required by 1.7 (130 X 1.7 = 221.0 sq in. louvered area). In this example, 2 grilles each having an 8 in. X 30 in. (240 sq in.) louvered area would be used. Fig. 5 shows grille locations.

ALL AIR FROM OUTDOORS

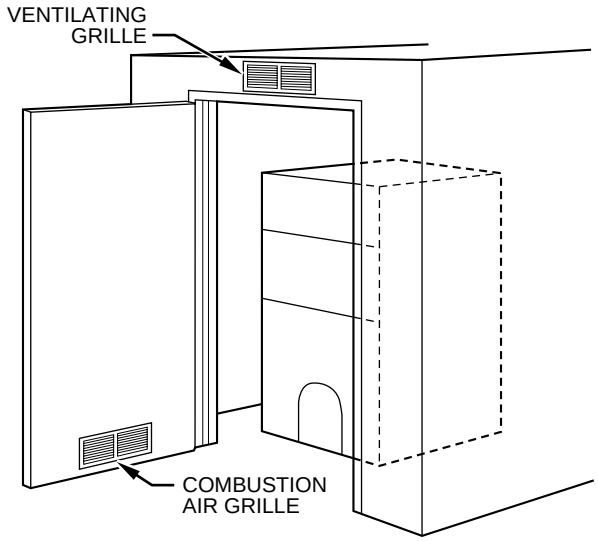
The confined space shall be provided with 2 permanent openings, 1 commencing within 12-in. of the top and 1 commencing within 12-in. of the bottom of the enclosure. The openings shall communicate directly, or by ducts, with the outdoors or spaces (crawl or attic) that freely communicate with the outdoors.

1. When directly communicating with the outdoors, each opening shall have a minimum free area of 1 sq in. per 4000 Btuh of total input rating of all equipment in the enclosure.
2. When communicating with the outdoors through vertical ducts, each opening shall have a minimum free area of 1 sq in. per 4000 Btuh of total input rating of all equipment in the enclosure.
3. When communicating with the outdoors through horizontal ducts, each opening shall have a minimum free area of 1 sq in. per 2000 Btuh of total input rating of all equipment in the enclosure.
4. When ducts are used, they shall be of the same cross-sectional area as the free area of the openings to which they connect. The minimum dimension of rectangular air ducts shall not be less than 3-in.

PROCEDURE 3—BOILERS WITH TANKLESS HEATER COIL

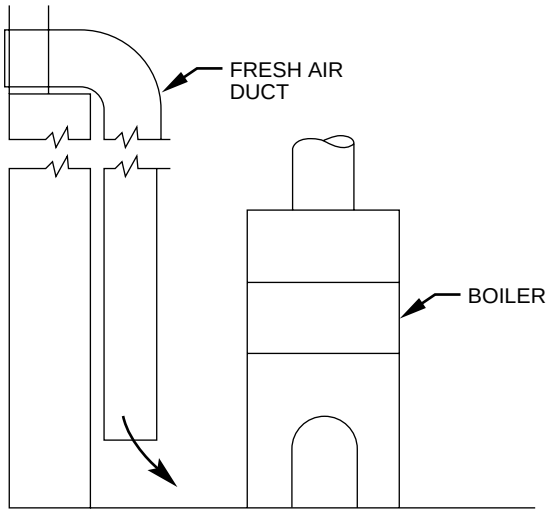
Boilers may be factory packaged with a tankless heater coil.

The use of this coil eliminates the need for a hot water storage tank. Instantaneous heating of water in the coil provides a flow of hot water for domestic use if proper burner and water supply line controls are used. Tankless coils are meant to provide domestic hot water for intermittent draws, not continuous flows.



A95594

Fig. 5—Air Openings for Closet of Utility Room Installations



A95595

Fig. 6—Fresh Air Duct for Tightly Sealed House

Table 2—Fresh Air Duct Capacities for Ducts Supplying Fresh Air to Boiler in Tightly Constructed Houses (Btuh)*

FRESH AIR DUCT SIZE (IN.)	1/4–IN. MESH SCREEN	WOOD LOUVERS	METAL LOUVERS
3-1/2 X 12	144,000	36,000	108,000
8 X 8	256,000	64,000	192,000
8 X 12	384,000	96,000	288,000
8 X 16	512,000	128,000	384,000

*Based on opening covered by 1/4-in. mesh screen, wood louvers, or metal louvers.

IMPORTANT: Do not use a tankless coil if water is excessively hard with lime or other deposits which will accumulate inside coil.

A. Mounting Aquastat Control

The control configuration on this boiler has been set up so that the Honeywell L8124C Combination Hi/Low Limit Aquastat Relay mounts on the tankless coil. This maximizes tankless coil performance by making the burner respond more quickly to a call for domestic hot water.

The boiler is completely wired according to schematic wiring diagram. (See Fig. 14.) The installer must mount the L8124C Aquastat on control well in 3/4-in. tapping on tankless coil. (See Fig. 7.)

B. Tankless Coil Piping

Piping is as shown in Fig. 8. A tempering valve (mixing valve) is recommended. A flow restrictor may be required on tankless coil inlet piping so that flow rates are matched to boiler heat input. See Table 3.

PROCEDURE 4—INSTALLATION SYSTEM PIPING

1. Place boiler in selected location as close to flue as possible. (See Fig. 4.) Boiler is shipped assembled. Only the factory-supplied relief valve needs be installed.

Table 3—Boiler Rating Information

BOILER MODEL		BURNER FIRING RATE (GPH)	INPUT (MBH)	TANKLESS RATING (GPM)
BW4BAH091	BW5BAH091	0.65	91	2.90
BW4BAH105	BW5BAH105	0.75	105	3.00
BW4BAH140	BW5BAH140	1.00	140	3.25
BW4BAH126	BW5BAH126	0.90	126	3.15
BW4BAH175	BW5BAH175	1.25	175	3.50
BW4BAH210	BW5BAH210	1.50	210	3.75
BW4BAH168	BW5BAH168	1.20	168	3.45
BW4BAH245	BW5BAH245	1.75	245	4.00
BW4BAH280	BW5BAH280	2.00	280	4.25

*Gallons of water per minute heated from 40°F to 140°F with 200°F boiler water temperature, intermittent draw.

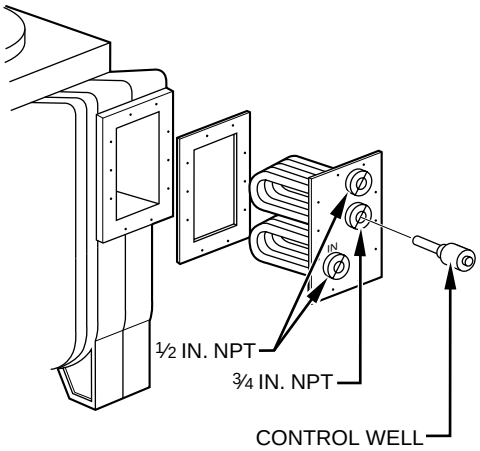
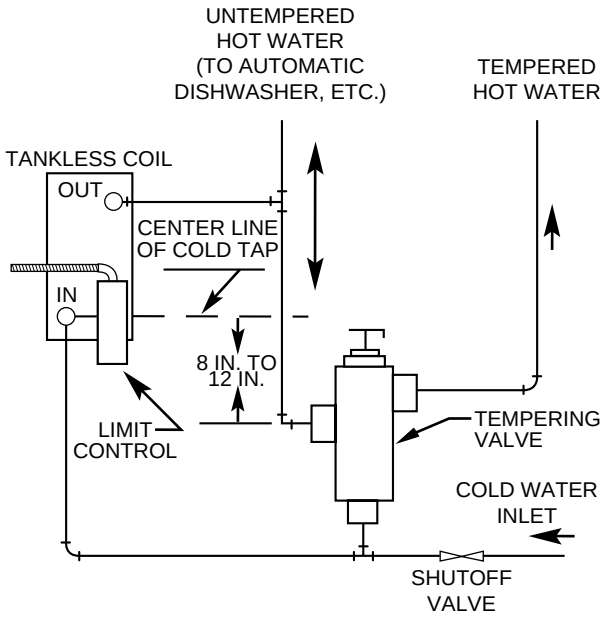


Fig. 7—Tankless Heater Coil

A95596



A98269

Fig. 8—Recommended Piping with Tankless Heater Coil

2. Install relief valve in rear section on 3/4-in. nipple and street ell. Do not connect directly to a drain, but leave an air gap. No shutoff of any description shall be placed between safety relief valve and boiler, or on discharge pipes between such safety valves and the atmosphere. Installation of safety relief valve shall conform to requirements of the ANSI/ASME Boiler and Pressure Vessel Code, Section IV. The manufacturer is not responsible for any water damage. Connect a drain line of the same pipe size (3/4-in.) to carry any water away to a drain.
3. Connect the 1–1/4-in. NPT supply and return lines to boiler. Both supply and return lines should be piped to the front section or both to the rear section. The boiler should NOT be piped return line to the front, supply line to the rear, or vice versa, as this will cause boiler water to short circuit heat exchanger. The connections may require certain additional fittings and parts as shown on diagrams. (See Fig. 9, 10, and 11.)

If installing an entire new heating system, first install all radiation units (panels, radiators, or cabinets) and supply and return mains, then make connections to boiler.

In connecting cold water supply to reducing valve, make sure that a clean water supply is available. When water supply is from a well or pump, a sand stainer should be installed at pump.

When boiler is used in connection with refrigeration systems, it shall be installed so that chilled medium is piped in parallel with the heating boiler with appropriate valves to prevent chilled medium from entering the heating boiler.

The minimum boiler supply water temperature setting on the aquastat is 140°F. If the boiler is used in a heating system where supply water temperatures below 140°F are desired, a suitable method, **such as, the use of bypass piping shown in the figure 10, a 3 way or 4 way mixing valve, or some other means** needs to be used to ensure return water temperatures to the boiler are no less than 120°F. When the boiler is operated with return water temperatures less than 120°F, condensation may form in the boiler and venting. This condensation is corrosive and can eventually cause severe damage to the boiler and venting system.

Antifreeze added to boilers must be non-toxic and must be of a type specifically intended for use in closed hydronic heating systems. Under no circumstances should automotive antifreeze be used. Antifreeze used in any boiler may reduce capacity by 10 percent or more and increase fuel consumption. Tankless coil performance will fall as concentration of antifreeze is increased. Refer to boiler and piping water volumes tables on next page.

PROCEDURE 5—CHIMNEY AND CHIMNEY CONNECTION

Follow local codes. In the absence of local codes, follow ANSI/NFPA 31 Installation of Oil Burning Equipment, latest revision.

A. Checking Chimney

The chimney is a very important part of the heating system. No boiler, however efficient its design, can perform satisfactorily if the chimney serving it is inadequate. Check chimney to make certain it is the right size, properly constructed, and in sound condition.

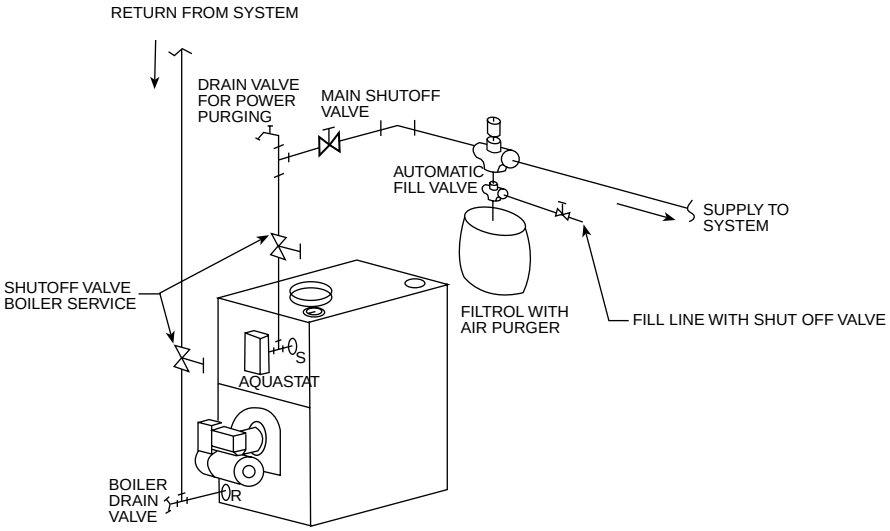
Table 4—Boiler Water Volumes

NUMBER OF BOILER SECTIONS	TOTAL VOLUME (GALLONS)
3	9.6
4	11.6
5	13.7

Table 5—Piping Water Volumes

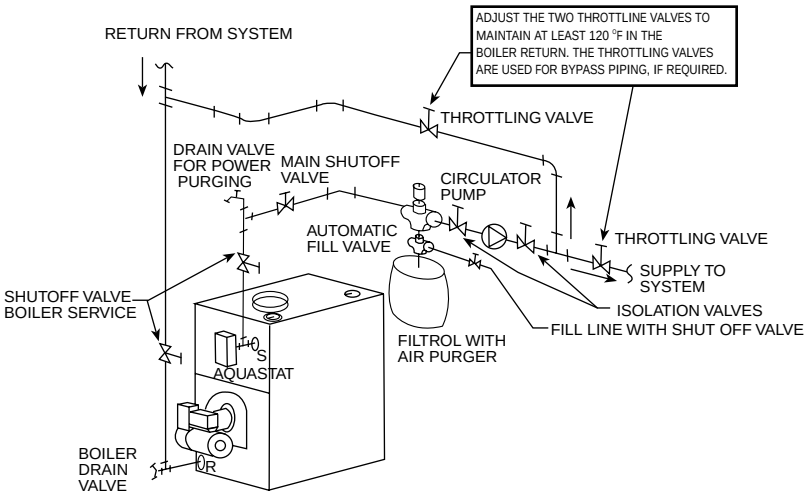
PIPE SIZE	COPPER PIPE FACTOR	STEEL PIPE FACTOR
1/2-in.	82.5	63.5
3/4-in.	40.0	36.0
1-in.	23.3	22.2
1-1/4-in.	15.3	12.8
1-1/2-in.	10.8	9.5
2-in.	6.2	5.8

—Divide total length of piping in feet by appropriate factor in table to determine volume in gallons.



A01032

Fig. 9—Circulator on Supply Pumping Away


ADJUST THE TWO THROTTLINE VALVES TO MAINTAIN AT LEAST 120 °F IN THE BOILER RETURN. THE THROTTLING VALVES ARE USED FOR BYPASS PIPING, IF REQUIRED.
RETURN FROM SYSTEM
THROTTLING VALVE
DRAIN VALVE FOR POWER PURGING
MAIN SHUTOFF VALVE
CIRCULATOR PUMP
AUTOMATIC FILL VALVE
THROTTLING VALVE
SUPPLY TO SYSTEM
SHUTOFF VALVE BOILER SERVICE
ISOLATION VALVES
FILL LINE WITH SHUT OFF VALVE
FILTROL WITH AIR PURGER
S
AQUASTAT
R
BOILER DRAIN VALVE

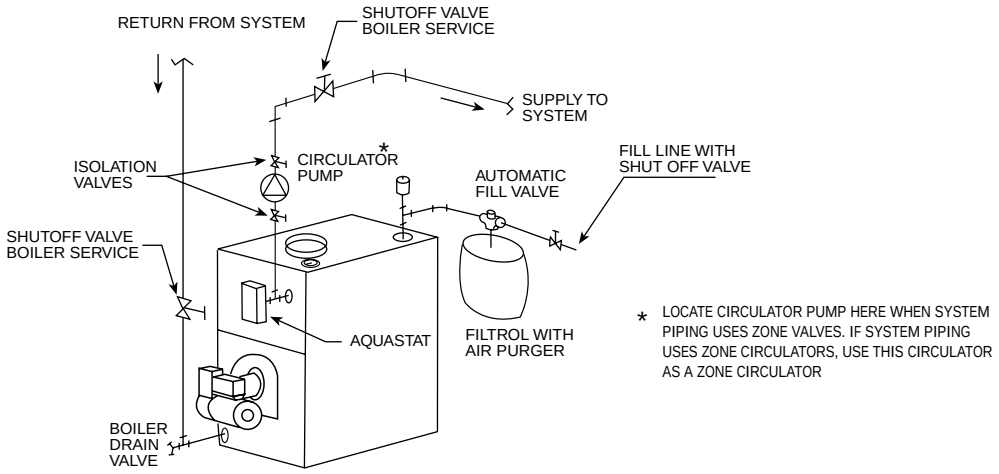
A01034

Fig. 10—Bypass Piping Circulator on Supply

→ It is cheaper to rebuild or reline a poor chimney than to pay excessive fuel bills. If chimney is an old masonry chimney, a new steel liner or a new prefabricated chimney may be the best solution. Refer to the manufacturer's instructions for correct sizing information.

Table 6 shows recommended minimum chimney sizes based on Table 3 and Fig. 6 of the I=B=R Testing and Rating Standard for Heating Boilers, Sixth Edition, June 1989.

For additional chimney design and sizing information, consult the ASHRAE 2000 HVAC System and Applications Handbook, Chapter 30, Chimney, Gas Vent and Fireplace Systems; or the National Standard for Chimneys, Fireplaces, Vents and Solid Fuel Burning Appliances, ANSI/NFPA 211.



A01035

Fig. 11—Piping Circulator on Supply Side

Table 6—Recommended Minimum Chimney Sizes

FIRING RATE (GPH)	CHIMNEY HEIGHT (FT)	NORMAL CHIMNEY AREA (IN.)	ROUND LINER INSIDE DIAMETER (IN.)	SQUARE LINER INSIDE DIMENSIONS (IN.)
0.60 to 1.30	15	8 X 8	6	6-3/4 X 6-3/4
1.31 to 1.80	15	8 X 8	7	6-3/4 X 6-3/4
1.81 to 2.00	20	8 X 8	8	6-3/4 X 6-3/4

—For elevations above 2000 ft above sea level, add 3 ft to chimney heights. (See Figure 12.)

B. Chimney Connector and Draft Regulator

Boiler requires 6-in. diameter chimney connector pipe. The draft regulator shipped with boiler must also be used. When properly installed, the regulator controls the draft automatically. It is best to install it in a horizontal section of the pipe, but it may be in an angled or vertical section. Make certain that the ″top″ is at top and that the short pipe section which holds vane is horizontal. Install it as close as practicable to boiler. (See Fig. 12.)

Install chimney connector as follows:

1. Start at boiler with a vertical pipe, at least 1 foot tall, and then an elbow.
2. Install draft regulator making it horizontal.
3. When regulator is in place, start at chimney and work back to regulator.
4. Join the 2 sections with a drawband. The horizontal pipe must slope up toward chimney at least 1/4-in. per ft. It must not leak and must be firmly supported.
5. Join sections with at least 3 sheet metal screws. Space evenly around the pipe
6. → Support every 5 feet with metal straps or stove pipe wire.

C. Minimum Vent Pipe Clearance

Wood and other combustible materials must not be closer than 18-in. from any surface of vent pipe.

PROCEDURE 6—ELECTRICAL WIRING

See Fig. 14 for wiring diagrams for the various models.

A. Installing Thermostat (Not Provided)

The 24-v thermostat location has an important effect on operation of boiler system. BE SURE TO FOLLOW INSTRUCTIONS INCLUDED WITH THERMOSTAT.

B. Grounding

Permanently ground boiler according to local codes and the current edition of The National Electrical Code. Run a 14 gage or heavier copper wire from boiler to a grounded connection in service panel or a properly driven and electrically grounded ground rod.

C. Electrcial Power Supply

⚠ WARNING: Turn off electric power at fuse box before making any line voltage connections. Follow local electric codes. Failure to follow this warning could result in electrical shock, personal injury, or death.

All electrical work must conform to local codes as well as the National Electrical Code. If not familiar with wiring and codes in general, have a competent electrician do this job.

Boiler controls are all wired at the factory. All that is required is to connect a 115-v electric supply and thermostat wires to aquastat relay.

Run a separate circuit from a separate overcurrent protective device in electrical service entrance panel. This should be a 15-amp circuit. Locate a shutoff switch at boiler. It must be turned OFF during any maintenance. Solder and tape or securely fasten these connections with wire nuts.

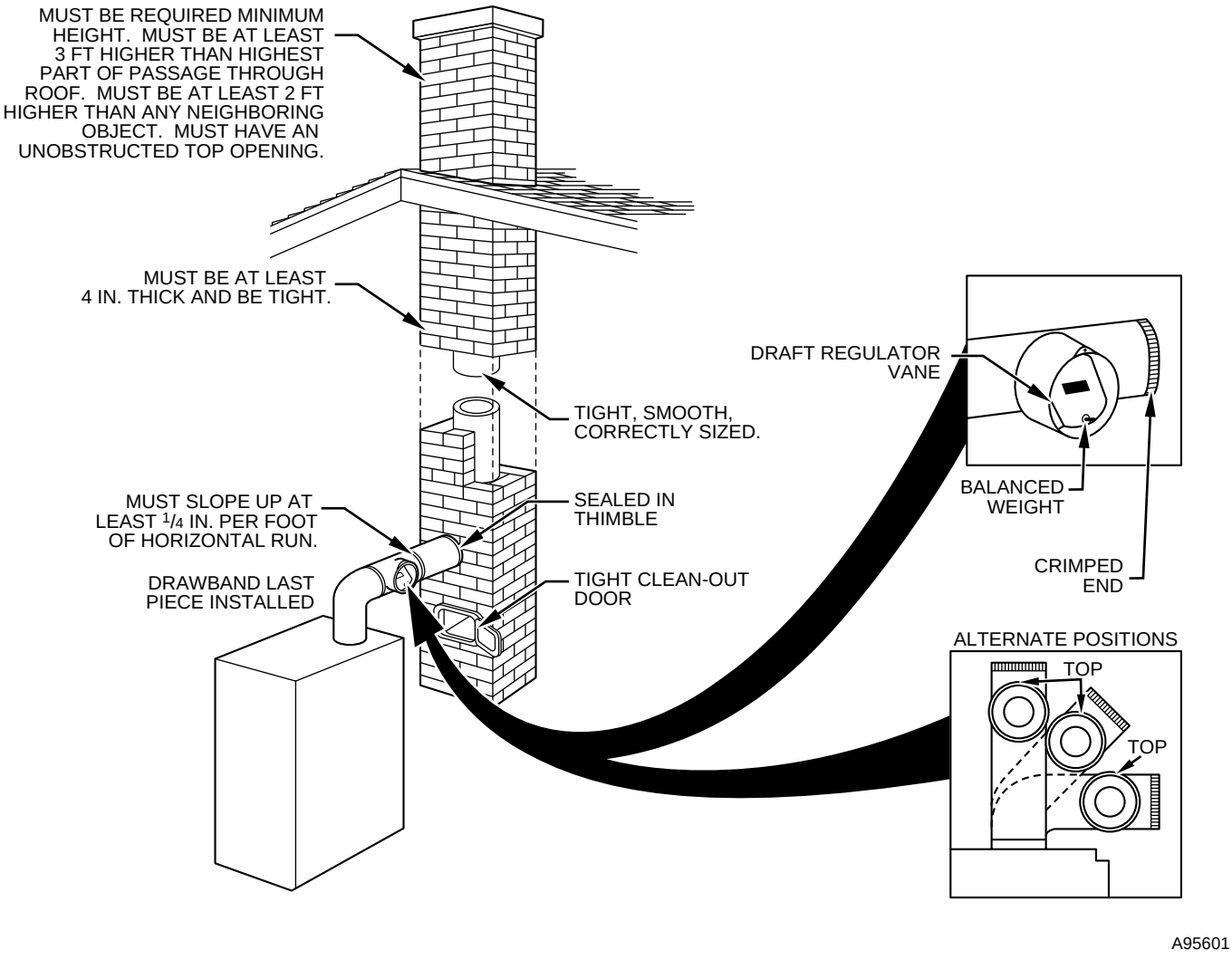

MUST BE REQUIRED MINIMUM HEIGHT. MUST BE AT LEAST 3 FT HIGHER THAN HIGHEST PART OF PASSAGE THROUGH ROOF. MUST BE AT LEAST 2 FT HIGHER THAN ANY NEIGHBORING OBJECT. MUST HAVE AN UNOBSTRUCTED TOP OPENING.
MUST BE AT LEAST 4 IN. THICK AND BE TIGHT.
TIGHT, SMOOTH, CORRECTLY SIZED.
SEALED IN THIMBLE
MUST SLOPE UP AT LEAST 1/4 IN. PER FOOT OF HORIZONTAL RUN.
DRAWBAND LAST PIECE INSTALLED
TIGHT CLEAN-OUT DOOR
DRAFT REGULATOR VANE
BALANCED WEIGHT
CRIMPED END
ALTERNATE POSITIONS
TOP
TOP
A95601

Fig. 12—Typical Chimney Requirements

D. Connecting 115–V Electrical Wiring to Boiler

Connect 115-v electric supply wires to terminals L1 and L2 on aquastat relay. (See Fig. 14.)

E. Thermostat Connections

The 2 wires from thermostat connect to terminals T and T on L8148A and L8124C aquastat relay (See Fig. 14.)

F. Thermostat Heat Anticipator Adjustment

Set heat anticipator at 0.2 amps. Measure the AMP draw of the thermostat circuit and adjust the anticipator setting if necessary.

PROCEDURE 7—EQUIPMENT AND OPTIONAL ACCESSORIES

A. Relief Valve (Required, Provided)

Each low-pressure hot water heating boiler is provided with a relief valve for over-pressure protection of boiler and heating system. The relief valve opens when pressure in boiler rises to 30 psig. Each relief valve is provided with a lifting device for testing and should be tested monthly during heating season. Escape piping should be provided from discharge side of relief valve so as to prevent scalding or other hazardous situations. The escape piping must remain full size and end at a safe point of discharge.

B. Expansion Tank (Not Provided)

In a properly assembled system, expanding water flows into an expansion tank. This tank should be of the correct size.

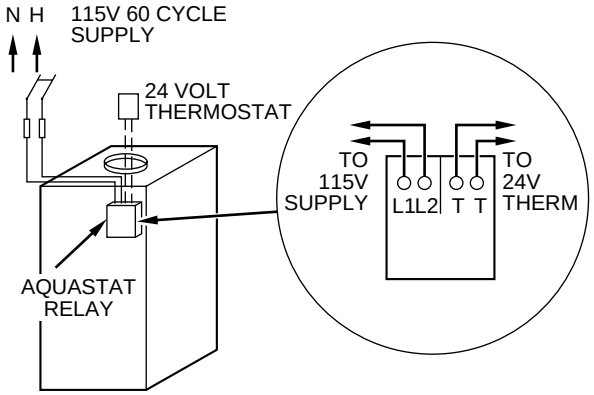
The tank is filled with air. As the water expands, it compresses the air in tank to form an air pressure cushion. This ″spring-like″ cushion serves to maintain correct operating water pressure regardless of water temperature. This assures a ″full measure″ of water even in the highest radiation unit of system. It also prevents blowing off the relief valve.

The air in tank in the beginning (with system filled with cold water) is sufficient for proper operation. The tank also serves as a trap for excess air in system. This air would cause gurgling in pipes and inefficient circulation in radiators if left in system.

It is possible for a tank to become ″water-logged″ (filled with water). It can also become overfilled with air. This can happen after filling system with new water. Fittings are provided on tank and in line to tank for bleeding off excess water or air.

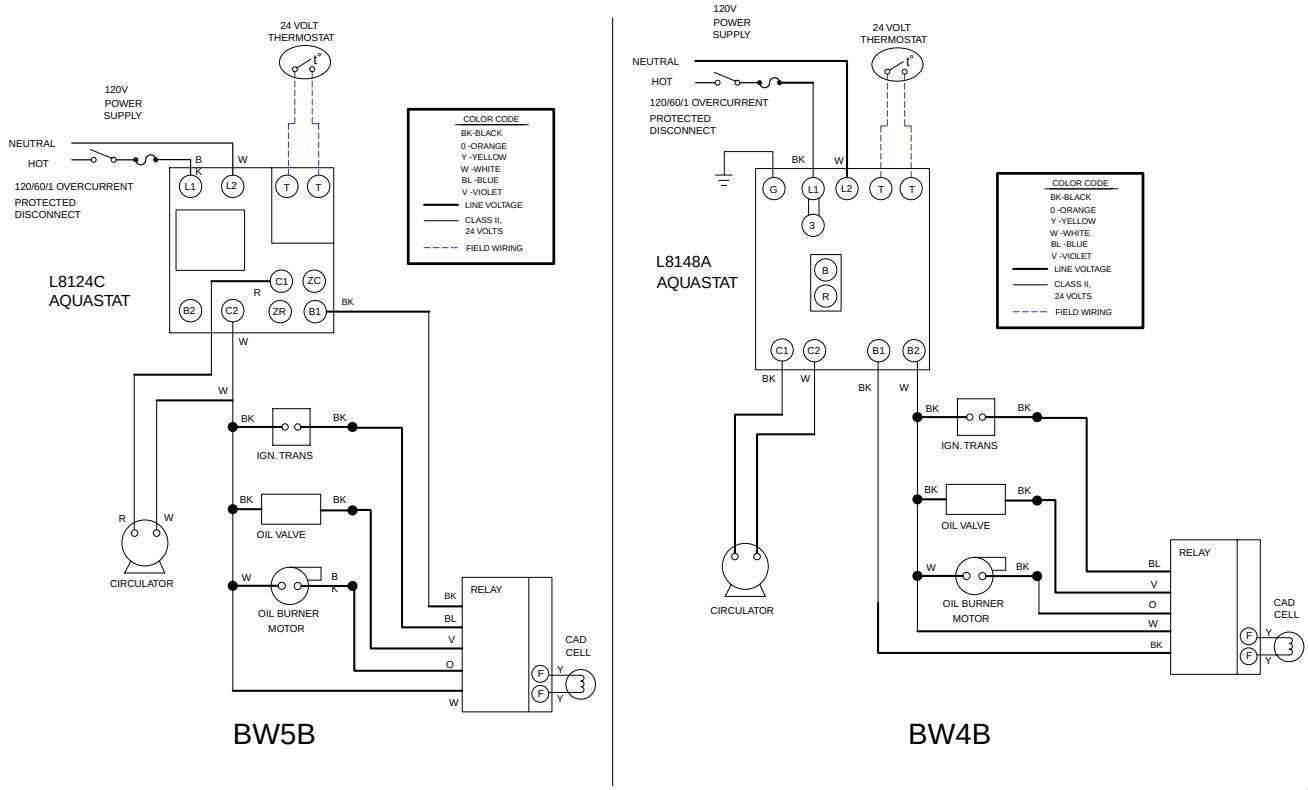
When installing this tank, the following are important:

1. Tank should be higher than boiler top.
2. Pipe to tank should continuously rise up to tank (so that air can ″bubble″ up through it).



A95602

Fig. 13—Wiring Connections to Aquastat Relay



A02231

→ **Fig. 14—Wiring Diagrams for Boilers With and Without Tankless Heater Coil**

C. Diaphragm-Type Expansion Tank (Not Provided)

The diaphragm-type expansion tank takes the place of a conventional expansion tank. Read instructions packed with tank assembly carefully.

The tank comes with a 10-12 psi air charge. This is the same as the pressure produced in system by automatic fill valve. When system is first filled, tank contains little or no water.

As water is heated, its pressure increases. It expands into tank compressing the air in tank. This compressed air cushion permits water in system to expand as temperature changes.

The diaphragm-type expansion tank can be mounted on the air purger fitting or at any other convenient place in the supply or return line. It is recommended to locate the diaphragm type expansion tank (a) in the supply line with the circulator located after the expansion tank or (b) off the 3/4-in. tapping provided on the top of the rear casting with the circulator mounted directly off the boiler's supply piping connection. This configuration allows the circulator to "pump away" from the expansion tank for improved air elimination and system performance. The air eliminator fitting or air purger is not provided. The air eliminator fitting or air purger is used to help remove air from the system before it reaches the radiators. It should be installed in the supply line. Air left in the system can cause noises in the pipes and inefficient circulation in the radiators.

D. Air Eliminating Fitting (Air Purger) (Not Provided)

An air purger is used to remove air from system. It is installed in supply line. It eliminates air from water before it reaches radiators and bleeds off this air.

E. Main Air Vent for Downflow Systems or Diaphragm-Type Expansion Tank (Not Provided)

Before a system is filled with water, there is air in pipes and radiation units. Some of it will be trapped as system fills. It is possible to eliminate most of this air through air vents on radiation units. A main air vent speeds and simplifies this process. It should be installed on highest point in supply main when all radiation is below top of boiler.

F. Aquastat Relay Control (Provided)

The water temperature limit control in aquastat relay is adjustable and may be set as necessary. It may be set as low as 140°F or as high as 240°F. This depends on type and amount of radiation involved and weather conditions.

G. Automatic Fill Valve (Not Provided)

For safe, efficient operation, a hot water system must be filled with water. Adding new water when needed can be done manually (by use of a hand valve in water supply line). This requires regular attention to system's needs. An automatic fill valve accomplishes this without attention. It is installed in supply line on hot water boilers only. The valve operates through water pressure differentials. It does not require electrical connection.

H. Drain Valve (Provided)

This manual valve provides a means of draining all water from boiler and system. It is installed in a tee where return line enters boiler.

I. Circulating Pump (Provided)

Every forced hot water system requires a circulating pump. A separate pump or zone valve is required for each zone if there are 2 or more zones.

The circulator must have the capacity to provide the circulation required by the heating system. The circulator should be connected to the supply main and must be wired into the boiler's electrical system. See the prior pages of installation section for piping configurations with the circulator located on the supply main piping using zone circulators or zone valves. When the piping is arranged with zone circulators and no bypass piping, the circulator provided with the boiler may be used as a zone circulator. Both piping arrangements allow the circulator to pump away from the expansion tank and show how the piping should be arranged to allow the heating system to be easily purged of air.

→ J. Oil Solenoid Valve

The Beckett oil burners have a delay solenoid valve which provides the same shutdown action as the standard solenoid valve, plus on burner start up the delay solenoid valve remains closed for an additional 15 seconds. This allows the burner fan motor to pre-purge the combustion chamber and the oil pump to bring the supply oil pressure up to its set point helping to provide a clean light off. The solenoid is incorporated.

PROCEDURE 8—FILLING BOILER

A. How a Hot Water System Operates

The entire heating system (boiler, piping, and radiation units) is filled with water. As water in boiler is heated, it is pumped from top of boiler through supply main to radiation units. The cooler water in them flows back through return main to boiler. This provides positive and rapid response to thermostat.

B. Filling System With Water

OPTION #1

a. **Close** the main shutoff valve, isolation valves, and zone valves (if applicable). If bypass piping is installed, also close the two throttling valves. Leave the boiler service shutoff valve (if installed) and the balancing valves to each heating zone **fully open.**

b. **Open** the following valves in order: the drain valve for power purging, isolating valves before and after the boiler circulator (if applicable), both throttling valves (if applicable), and then open the fill line shutoff valve. Water will fill the bypass piping and push air through the piping and out the power purging drain valve. When the power purging drain valve runs air free, close the bypass throttling valve (leaving the throttling valve to the supply piping fully open).

c. Next, **open** the isolation valve (or zone valve) to the first zone. Water will fill the piping and push any air out the power purging drain valve. When the power purging drain valve runs air free, close the isolation valve or zone valve. Repeat this procedure for the remaining heating zones.

d. Once all of the zones are filled with water and purged of air, **close** the power purging drain valve and fill line shut off valve, **open** the main shutoff valve, and **adjust** the throttling valves and balancing valves as required.

OPTION #2

1. Close air vents on all radiation units. Open valves to these units.
2. Make sure boiler and expansion tank drain cocks are closed. The air bleed screw on tank drain fitting should be closed.
3. Open valve in line from boiler to expansion tank.
4. Open water inlet to boiler and leave it open.
5. Start with the LOWEST radiation unit. Open the air vent on this radiation unit. When all air has escaped and water starts to flow from vent, close air vent.
6. Proceed to next lowest radiation unit and repeat process outlined in item 5. Repeat until every radiation unit in system has been covered. End with the highest unit in system.

If units have automatic vents, this manual venting is unnecessary but will speed up proper filling of system.

If system is a closed expansion tank system, there should be an automatic fill valve. It may be left open to refill system automatically as needed. Check temperature-pressure gage. Note position of hand indicating pressure. This should be between 10 and 15 psi. Any lowering of this movable hand below 10 psi indicates loss of water due to leakage. The automatic fill valve should compensate for this. If it does not, manually open this valve to refill system until hand is again pointing to same pressure reading. Instructions are packaged with valve.

OPERATING BOILER

⚠ **CAUTION: Do not tamper with the unit or controls.**

IMPORTANT: Follow these instructions carefully.

PROCEDURE 1—TO START

Fill entire system with water. Vent all air from system. Refer to instructions included with oil burner.

PROCEDURE 2—FUEL UNITS AND OIL LINES

The oil burner is provided with a single-stage 3450 RPM fuel unit with bypass plug removed for a single-pipe installation. This is satisfactory where fuel supply is on same level or above burner, permitting gravity flow of oil. Never exceed 3 psi pressure to suction side of fuel unit. A pressure over 3 psi may cause damage to shaft seat and allow it to leak oil.

When it is necessary to lift oil to burner, a return line should run between fuel unit and oil supply. If lift exceeds 10 ft, a 2-stage fuel unit must be used with a return line. When a 2-line installation is made, bypass plug must be installed. This is supplied with burner attached to fuel unit along with a fuel pump data sheet in a plastic bag.

When oil lines are installed, continuous runs of heavy wall copper tubing is recommended. Be sure that all connections are absolutely airtight. Check all connections and joints. Flared fittings are recommended. Do not use compression fittings.

See pump data sheet for sizing, lift, and length of tubing recommendations. Use an oil filter of adequate size for all installations. Install inside building between tank shutoff valve and burner. For ease of servicing, locate shutoff valve and filter near burner.

PROCEDURE 3—AIR SUPPLY FOR COMBUSTION

Do not install in rooms with insufficient air to supply combustion. Occasionally, it is necessary to install windows or cut holes in a door to these rooms to obtain sufficient air and to prevent less than atmospheric air pressure in the room. If there is a lack of combustion air, the burner flame will be yellow and formation of soot will occur in heating unit. In buildings of conventional frame, brick, or stone construction without utility rooms, basement windows, or stair doors, infiltration is normally adequate to provide air for combustion and operation of barometric draft control. The room should be isolated from any area served by exhaust fans. Do not install exhaust fans in this room. See Fresh Air for Combustion section earlier in this document.

PROCEDURE 4—DRAFT REGULATORS (PROVIDED)

A draft regulator is required. It should preferably be mounted in smoke pipe. Use a draft gage to adjust to proper opening. When burner air supply and draft are properly adjusted, combustion chamber draft will be approximately -0.01 to -0.02 in. wc and stack draft will be -0.02 to -0.04 in. wc. The larger the installation, the greater the draft required at stack to obtain -0.01 to -0.02 in. wc at combustion chamber.

PROCEDURE 5—NOZZLES (PROVIDED)

Use the proper size, type, and spray pattern nozzle, refer to Table 6. To install nozzle, loosen clamping screw on retention ring assembly and slide assembly off adapter. Install and tighten nozzle in adapter. Be careful not to damage electrode insulators or bend electrodes. Replace retention ring assembly on adapter. Make sure clamp is tight against shoulder on adapter. Tighten clamping screw. Check electrode setting. (See Fig. 17–19.)

PROCEDURE 6—FINAL BURNER ADJUSTMENTS

A final adjustment must be made with the use of a COMBUSTION TEST KIT. Initial settings for burner are shown on label on top of ignition transformer and Table 7. Set burner accordingly. After operating 10 minutes to warm unit up, a smoke tester should be used to take a smoke reading in flue pipe between boiler and draft regulator. Smoke should be zero (Shell Bacharach Scale). At times a new boiler requires more time than this to burn clean due to oil film on a new heat exchanger. Check draft over the fire. This should be -0.01 to -0.02 in. wc as previously stated. Adjust draft if necessary. Gradually close air shutter, and if necessary the air band, to obtain a smoke reading showing a trace of smoke. Measure CO_2 at this point. Increase air sufficiently to reduce CO_2 by 0.5 to 1 percent as an insurance margin. Smoke should be zero. If a clean fire cannot be obtained, it will be necessary to verify head and electrode alignment. (See Fig. 15–17.) If fire is still smoky, replace nozzle with a correct replacement. Record nozzle size, oil pressure, combustion readings and air settings then place a tag or label on boiler or burner with this information. Units should be cycled several times to assure good operation with no fluttering or rumbling. Check for oil leaks.

PROCEDURE 7—OIL BURNER MAINTENANCE

The following preventative maintenance items should be performed annually, preferably prior to the heating season.

A. Oil Burner Motor

Add 2-3 drops of non-detergent electric motor oil to each oil cup located at front and rear of motor. Excessive oiling will shorten the life expectancy of motor.

B. Fuel Filter

This should be replaced so as to prevent contaminated fuel from reaching the nozzle. A partially blocked fuel filter can cause premature failure of fuel pump unit.

C. Fuel Pump Unit

Replace pump screen and clean pump unit to maintain reliable fuel delivery to nozzle.

D. Ignition Electrodes

Clean and adjust as per manufacturer's recommendations so as to maintain reliable ignition of oil.

E. Nozzle

Replace so as to maintain safe and reliable combustion efficiency. Always replace with the exact nozzle as required in Table 7.

F. Fan and Blower Housing

These must be kept clean and free of dirt, lint, and oil so as to maintain proper amount of air the fuel requires to burn.

NOTE: If any component parts must be replaced, always use parts recommended by burner manufacturer.

PROCEDURE 8—CHECKING AND ADJUSTING CONTROLS

⚠ WARNING: Do not attempt to start the burner when excess oil has accumulated, when unit is full of vapor, or when the combustion chamber is very hot. Failure to follow this warning could result in fire, personal injury, or death.

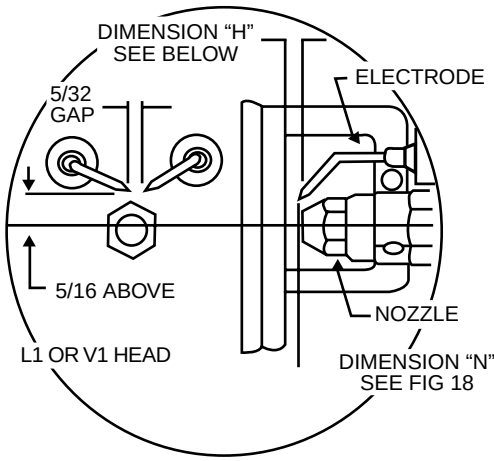
IMPORTANT: These instructions must be followed carefully.

Table 7—Oil Burner Specifications

BASE MODEL	BOILER INPUT (BTUH)	DELEVAN OIL NOZZLE	FIRING RATE (GPM)	HEAD-ADJUSTMENT OR SETTING	LOW FIRE BAFFLE	AIR SHUTTER	AIR BAND	STATIC PLATE (IN.)	PUMP PRESSURE
140	91,000*	0.50–80 B	0.65	F0 1-1/8	Yes	10	0	3-5/8	175 psig
	105,000	0.65–70 B	0.75	F3 1-1/8	Yes	10	0	3-1/2	140 psig
	140,000	0.85–70 B	1	F3 1-1/8	No	10	2	3-1/2	140 psig
210	126,000*	0.75–80 A	0.9	F3 1-1/8	No	8	0	3-1/2	140 psig
	175,000	1.00–80 A	1.25	F6 1-1/8	No	10	0	3-3/8	140 psig
	210,000	1.25–80 A	1.5	F6 1-1/8	No	10	2	3-3/8	140 psig
280	168,000	1.00–60 B	1.2	V1-0	No	10	1.5	2-3/4	140 psig
	245,000	1.50–45 B	1.75	V1-2	No	10	4	2-3/4	140 psig
	280,000	1.65–60 B	2	V1-4	No	10	5	2-3/4	140 psig

* Requires field-supplied accessory Low Fire Kit.

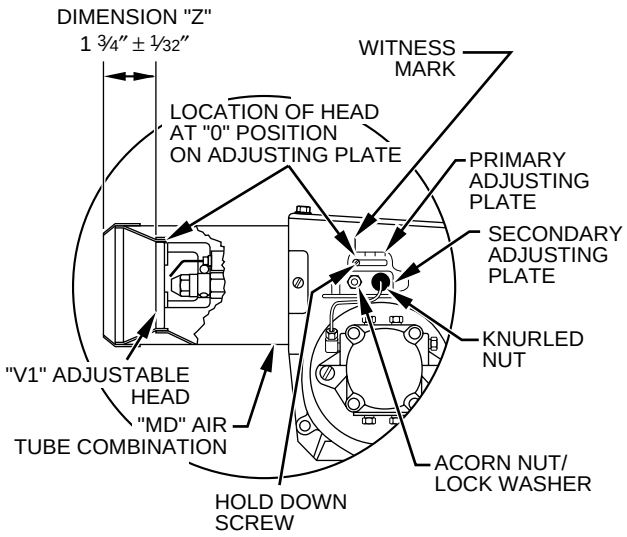
Pump is factory set at 140 psig. Raise pump pressure to 175 psig after installing low fire kit for 91,000 Btuh input.



A01064

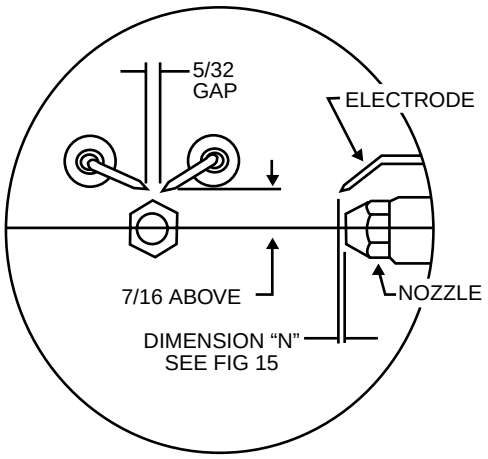
UNIT SIZE	HEAD	DIMENSIONS (IN.)	
		N	H
140	F0, F3	1/16	N/A
210			
280	V1	1/16	7/32 to 9/32

Fig. 15—Beckett Burner Electrode Adjustments (For V1 280 Heads)



A95604

Fig. 16—Beckett Burner Setting Variable (V1) Head



A02245

Fig. 17—Beckett Burner Setting Fixed (F) Head — 140, 210

A. Adjusting Operating Controls

Instructions for each control are included. Refer to Table 8 for recommended settings for the first adjustment:

These settings can be changed after gaining familiarity with how system responds. If system does not give quite enough heat in very cold weather, the high limit setting can be raised to 220°F. If more domestic hot water is required, the low limit setting can also be raised.

Table 8—Recommended Operating Control Settings

OPERATING CONTROL		CONTROL SETTING
High Limit	Standing Radiators	180°F
	Baseboard and Convectors	200°F
Low Limit (When Used)		140°F
Differential (When Used)		10°F

B. Checking Thermostat Operation

When set above temperature indicated on thermometer, boiler burner should start. Make certain thermostat shuts boiler down when room temperature reaches selected setting and starts boiler operating when room temperature falls a few degrees.

NOTE: Do not start burner unless all cleanout doors are secured in place.

MAINTENANCE

To assure trouble-free operation, we recommend that flue passages, burner, combustion chamber area (target wall and fire door insulation), burner adjustment, operation of controls, and boiler seals (door gasket or silicone seal, cast iron seals and flue collector) be checked ONCE EACH YEAR by a competent service technician.

BEFORE THE START OF EACH SEASON (or whenever system has been shut down for some time), recheck the whole system for leaks and recheck boiler and vent pipe for leaks. Replace or patch any boiler seals that are faulty.

⚠ **WARNING: Never burn garbage or paper in the unit, and never leave combustible material around it.**

PROCEDURE 1—RELIEF VALVE

This valve should open automatically when system pressure exceeds the safe limit (30 psi). Should it ever fail to open under this condition, shut system down. Drain it until pressure is reduced below safe limit, then have valve replaced immediately. The relief valve should be tested monthly during heating season. Prior to testing, make certain a discharge pipe is properly connected to the valve outlet and arranged so as to contain and safely dispose of boiler discharge. Hold the trip lever fully open for at least five seconds in order to flush free any sediment that may lodge on the valve seat. Then permit the valve to snap shut.

PROCEDURE 2—CONVENTIONAL EXPANSION TANK

As previously noted, this tank may become waterlogged or may receive an excess of air. Frequent automatic opening of relief valve indicates waterlogging. A high boiler temperature accompanied by unusually low radiation unit temperature (and ″knocking″) indicates excess air in tank.

To correct either condition, close valve between boiler and tank. Drain tank until it is empty. Check all tank plugs and fittings. Tighten as necessary. Open valve between boiler and tank. Water will rise to normal height in tank if automatic fill valve is installed, otherwise, manually refill system.

PROCEDURE 3—DIAPHRAGM EXPANSION TANK

As previously noted, this tank may become waterlogged or may receive an excess of air. Frequent automatic opening of relief valve indicates waterlogging. A high boiler temperature accompanied by unusually low radiation unit temperature (and ″knocking″) indicates excess air in tank. To correct this condition, replace the diaphragm expansion tank.

PROCEDURE 4—WATER SYSTEM

If system is to remain out of service during freezing weather, always DRAIN IT completely. Water left in to freeze will crack pipes and/or boiler.

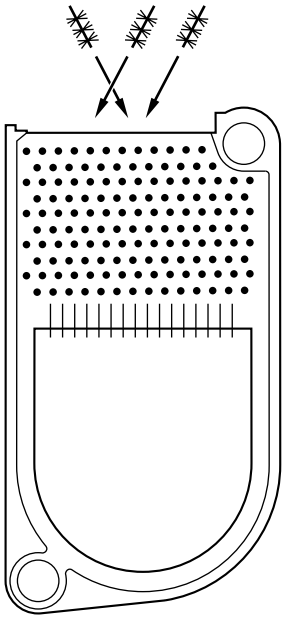
PROCEDURE 5—TANKLESS COIL (OR COVER PLATE) GASKET

The tankless coil gasket should be checked at least twice a year for leakage and replaced if necessary.

PROCEDURE 6—OIL BOILER/BURNER CLEANING INSTRUCTIONS

OIL BOILER CLEANING

1. Shut off all electrical power to the boiler/burner and shut off fuel oil supply.
2. Remove the vent pipe from the top of the boiler. Inspect the pipe and chimney for signs of corrosion and deterioration. Clean out the base of the chimney. If the vent pipe shows any signs of corrosion or deterioration, replace it immediately. If chimney damage or deterioration is discovered, contact a competent professional.
3. Remove the top jacket panel screws (5), the brass wing nuts (2) holding the flue collector top, and then the flue collector top. Inspect the gasket on the underside of the flue collector and replace as necessary.
4. Before beginning to clean the flue passageways, ensure that the combustion chamber blanket is covered. If the blanket is not covered prior to cleaning, replace the blanket once cleaning is complete.
5. Now with access to the flue passageways, remove the soot from the fireside surfaces by brushing diagonally through the flue passages (See Fig. 18). Brushing can be made easier by cutting the end of the flue brush off and inserting it into a drill. When brushing, care should be taken so as not to damage the target wall with the flue brush.
6. Carefully vacuum the soot accumulations from the combustion chamber area, being particularly careful to not damage any of the refractory or blanket insulation. To gain access to the combustion chamber first double check that the shut off valve on the fuel line is closed and then disconnect the fuel oil line. Then open the swing door by simply removing the whiz lock nut holding the door shut.
7. Now inspect the target wall, fire door refractory, and combustion chamber blanket (when included) for cracking and deterioration. If there is any signs of cracking or deterioration, replace the refractory or blanket before reassembling the burner/front plate.



A95609

Fig. 18—Removing Soot

8. Inspect the door's braided gasket for wear and damage. Replace when necessary with braided gasket of the same material and size. See repairs parts section of this manual.
9. Now inspect and clean the oil burner.

OIL BURNER CLEANING

NOTE: These are general instructions for cleaning an oil burner. For specifics, consult the burner manufacturer's instructions

1. Make sure all electrical power to the boiler/burner and the fuel supply to the burner are shut off.
2. With the swing door open, clean any soot accumulations from the end of the burner and if applicable burner head.
3. Remove the burner drawer assembly, clean the electrodes and then reset the electrode spark gap per the manufacturer's recommendations.
4. Replace the oil nozzle with the exact same size and type recommended for use on this boiler.
5. Reinstall the burner drawer assembly making sure the head location (and size if applicable) are per the manufacturer's recommendations. If the burner being used has a damaged head, replace the head with the exact same head recommended for use on this boiler.
6. Inspect and clean the oil burner blower wheel.
7. Remove the oil pump cover and clean/replace the pump screen. Carefully reassemble ensuring the pump cover makes a good seal.
8. Securely fasten the swing door shut.
9. Replace the fuel filter (if applicable).
10. Reconnect the electrical and fuel supplies.
11. Fire the burner, checking for proper combustion using combustion test equipment and making adjustments as necessary.
12. Ensure that all safety controls and operating controls are functionally properly.

IMPORTANT: KEEP BOILER AND AREA AROUND IT CLEAN. NEVER BURN REFUSE OR ANY MATERIAL OTHER THAN THE SPECIFIED FUEL IN BOILER. HAVE BOILER CHECKED EACH YEAR BY A QUALIFIED TECHNICIAN.

PROCEDURE 7—SEQUENCE OF OPERATION-

Refer to Fig. 19 and the wiring diagram shown in Fig. 14 while reviewing sequence of operation.

A. Boiler with Tankless Coil

HIGH LIMIT CONTROLLER

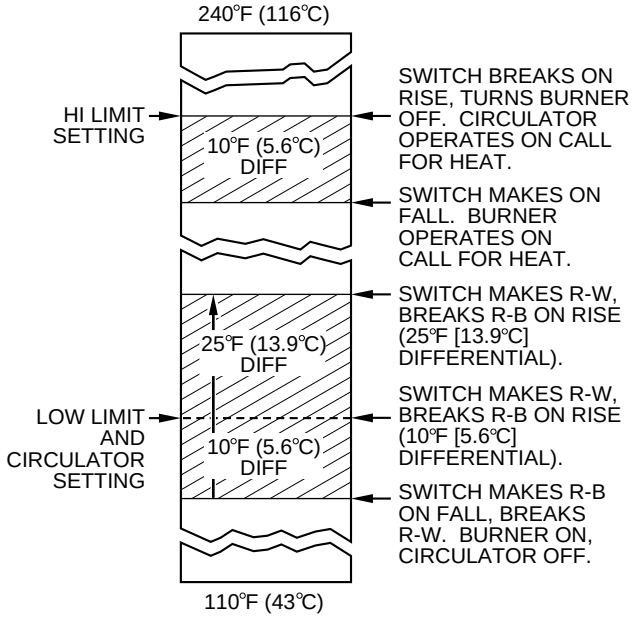
The high limit contacts open and turn burner off when boiler water temperature reaches high limit set point. The high limit automatically resets after boiler water temperature drops past set point and through fixed 10° differential.

LOW LIMIT AND CIRCULATOR CONTROLLER

On a boiler water temperature rise, with the adjustable differential set at the minimum setting of 10°, burner circuit contacts RB break and circulator circuit contacts RW make at low limit set point. On a boiler water temperature drop of 10° below set point, the RB circuit makes and RW circuit breaks.

At any differential setting greater than 10°, the RB make and RW break temperature remains the same (control setting minus 10°). The RB break and RW make temperature is the set point temperature plus the difference between differential setting and 10°.

The low limit control fires burner to maintain boiler water temperature at low limit setting (set point plus adjustable differential setting minus 10°). While boiler water temperature is below low limit setting, circulator is prevented from operating, giving preference to domestic hot water requirements. Once boiler water temperature rises to low limit setting, thermostat controls firing of burner and operation of circulator pump as follows:


240°F (116°C)
HI LIMIT SETTING
10°F (5.6°C) DIFF
SWITCH BREAKS ON RISE, TURNS BURNER OFF. CIRCULATOR OPERATES ON CALL FOR HEAT.
SWITCH MAKES ON FALL. BURNER OPERATES ON CALL FOR HEAT.
SWITCH MAKES R-W, BREAKS R-B ON RISE (25°F [13.9°C] DIFFERENTIAL).
25°F (13.9°C) DIFF
LOW LIMIT AND CIRCULATOR SETTING
SWITCH MAKES R-W, BREAKS R-B ON RISE (10°F [5.6°C] DIFFERENTIAL).
10°F (5.6°C) DIFF
SWITCH MAKES R-B ON FALL, BREAKS R-W. BURNER ON, CIRCULATOR OFF.
110°F (43°C)

A95611

Fig. 19—Relationship of Set Points and Differential

1. Thermostat calls for heat completing circuit between terminals T and T on L8124C aquastat controller energizing the 1K relay coil.
2. With 1K relay coil energized, contacts 1K1 and 1K2 are closed. Terminal B1 is energized providing power to R4184 oil burner primary control. This in turn powers ignition coil and burner motor.
3. With R4184 primary control energized, burner operation starts and burner remains running as long as cad cell senses flame. In the event of a flame failure or if flame is not fully proven within 45 sec of initial start-up, the R4184 primary control locks out and opens burner circuit. This requires a manual start-up of burner.
4. As long as flame is proven through cad cell relay, burner remains on until circuit is interrupted by boiler water temperature reaching high limit setting (opening high limit contacts BR), or thermostat is satisfied breaking T-T circuit.
5. Circulator pump is powered through terminal C1 and runs when boiler water temperature is above low limit setting.
6. If boiler water temperature reaches high limit setting, high limit contacts BR open de-energizing terminal B1 and shutting off burner. Circulator pump remains running as long as thermostat calls for heat.
7. If boiler water temperature falls 10° below high limit setting, contacts BR close energizing burner.
8. Thermostat is satisfied terminating call for heat. Relay coil 1K is de-energized opening 1K1 and 1K2 contacts. Both burner and circulator pump cease operation.

NOTE: The high limit setting must be set a minimum of 20° higher than low limit setting.

B. Boiler Without Tankless Coil

AQUASTAT HIGH LIMIT CONTROLLER

The aquastat control's high limit contacts open and turn off the burner when the boiler water temperature reaches the control's high limit set point. The high limit contracts automatically reset after the boiler water temperature drops past the set point by 10° F, which is a fixed differential.

When the thermostat controls call for domestic space heating, the sequence of operation for the burner and circulator is as follows:

1. Thermostat calls for heat, completing the circuit between terminals T and T on the aquastat controller, energizing the 1K relay coil.
2. With the 1K relay coil energized, contacts 1K1 and 1K2 are closed. Terminals C1 and C2 are enegerized providing power to the circulator. Terminal B1 is energized, providing power to the oil burner primary control. This in turn powers the ignition coil and burner motor.
3. With the primary control energized, the burner operation starts and remains running as long as the cad cell senses flame. In the event of flame failure or the flame is not fully proven within the trial for ignition period, the primary control will lockout and open the burner circuit. This will require a manual startup of the burner.
4. As long as flame is proven through the cad cell relay, the burner will remain on unit the circuit is interrupted by the boiler water temperature reaching the aquastat's high limit setting (opening high limits contracts BR), or the thermostat is satisfied breaking the T—T circuit.
5. If the boiler water temperature reaches the aquastat's high limit setting, the high limit contact BR is de-energized turning the burner off. However, the circulator pump will continue to run, as long as, the thermostat calls for heat.
6. After the high limit contact BR is de-energized, the boiler water temperature must fall 10° F below the aquastat's high limit setting for the high limit contacts BR to close and energize the burner.
7. When the thermostat is satisfied, the call for domestic space heating is ended. Relay coil 1K is de-energized, opening 1K1 and 1K2 contacts. Both the burner and circulator pump operation stop.

PROCEDURE 8—SERVICE HINTS

Avoid inconvenience and service calls by checking these points before calling for service.

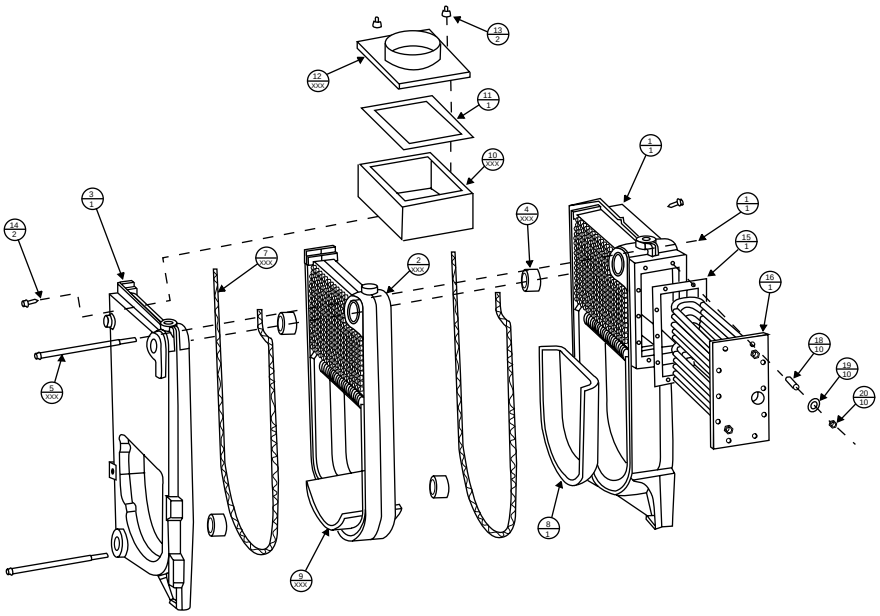
HAVE YOUR SERVICE TECHNICIAN CHECK ANY PROBLEM YOU ARE UNABLE TO CORRECT.

Table 9—Service Hints

IF SYSTEM IS NOT HEATING OR NOT GIVING ENOUGH HEAT. . .	
POSSIBLE CAUSE	WHAT TO DO
Thermostat is not set correctly	Reset thermostat above room temperature.
Boiler and/or burner may be dirty	Clean all flue passages and vent pipe. Have burner cleaned and readjusted.
Burner may not be firing at proper rate	Check nozzle size it there is any doubt. Have burner adjusted.
Burner may be short-cycling	Burner may be short-cycling Short-cycling (too frequent off and on) of burner causes sooting. If boiler and/or burner becomes dirty at frequent intervals, correct the ″dirt condition,″ then also correct the control setting (or other cause of short-cycling). Check thermostat heat anticipator and correct setting, if necessary, per instruction sheet packed with thermostat.
No power to boiler	Check overcurrent protection. Check to be sure power supply circuit is on.
Controls out of adjustment	Reset according to instructions packed with controls.
Radiators not heating	Open radiator vents to vent excess air. Check flow control valve (if used). It may be in closed position.
Circulator pump not running	Check relay operation.
Poor electrical contact	Check all control terminals and wire joints.
IF BURNER IS NOISY. .	
POSSIBLE CAUSE	WHAT TO DO
Oil burner fan wheel may be dirty	Clean fan wheel with a stiff brush and cleaning solvent. Readjust oil burner.
Draft regulator may be stuck	Check to see if vane swings freely. Clean if vane is stuck.
IF RADIATORS ARE NOISY. . .	
POSSIBLE CAUSE	WHAT TO DO
Air in system	Open radiator vents to vent air. Check expansion tank.
RELIEF VALVE LEAKING. . .	
POSSIBLE CAUSE	WHAT TO DO
Dirt on seat	Open valve manually. Allow water to run and clear valve seat.
Waterlogged expansion tank	Drain tank. See instructions.

PROCEDURE 9—PARTS LIST

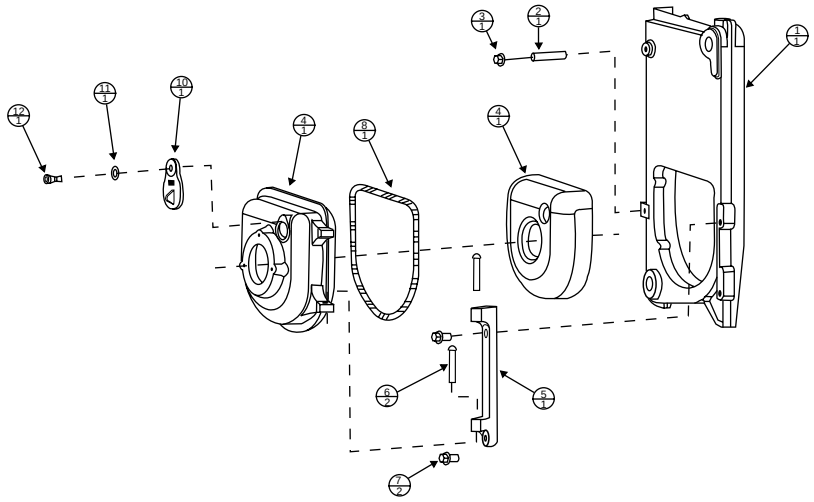
All parts are listed in the following Parts Lists. Parts may be ordered through nearest supplier When ordering parts, first obtain the Model No. from the name plate on boiler, then determine the Part No. (not the Key No.) and the Description of each part from the following appropriate illustration and list. Parts for which no Part No. is given are standard items which can be procured locally. Be sure to give all this information: The Part No., The Part Description, The Boiler Model No.



A01039

ITEM	DESCRIPTION	PART NUMBER
1	Section Machined Back	403–00–008
2	Section Machined Middle	403–00–007
3	Section Machined Front	403–00–006
4	Nipple Machined 2-in. — (2-in. cast iron push nipple)	433–00–976
5	Tie Rod 1/4 X 10 1/4	
	3 section	146–05–002
	4 section	146–05–051
	5 section	146–05–053
6	Nuts head (Hex) ZP (Zinc Plated) 1/4-in. — 20	146–95–041
7	Cut Rope 5/18-in. X 70–1/2-in. (NORFAB 400 Serrated Braided Rope)	433–00–955
8	Target Wall (Gemcolite Vacuum Formed Ceramic Fiber 2300')	146–19–003
9	Dura Blanket 3–8 # 1/2-in. thick Size — 3 section-8-in. X 12-in., 4 section— 8-in. X 20-in., 5 section— 8-in. X 20-in	146–30–031
10	Collector Base	
	3 section	425–00–279
	4 section	425–00–280
	5 section	425–00–281
11	Tape Plym Collector insulation 1-in. X 1/16-in. X 100	Included in part # 425–00–279, 80, 81
12	Collector Top	Included in part # 425–00–279, 80, 81
13	Wing Nut 8/32 — Brass	137–04–007
14	Screw #14 X 3/4- in. HWH SL S.M. SC. (Hex Washer Head, Slotted, Sheet Metal Screw)	146–95–109
15	Gasket PF-EV 5040–150A	146–93–064
16	Coil 3.7 GPM (Gallons Per Minute) CDB	146–27–020
17	Cover Plate (Not Shown)	146–19–001
18	Stud 18–8 ST. ST.(Stainless Steel) 3/8-16 X 1–1/2-in.	146–95–113
19	Washer Flat 18–8 St. ST.(Stainless Steel) 3/8	146–95–114
20	Nut Top Lock 18–8 St. ST(Stainless Steel) 3/8	146–95–115
21	Plug Solid Black Square Head 1–1/4-in. (Not Shown)	146–93–126
22	400° Black Silicone Rubber Adhesive Sealant (Not Shown)	146–06–020

→ **Fig. 20—Exploded Basic Block Assembly**



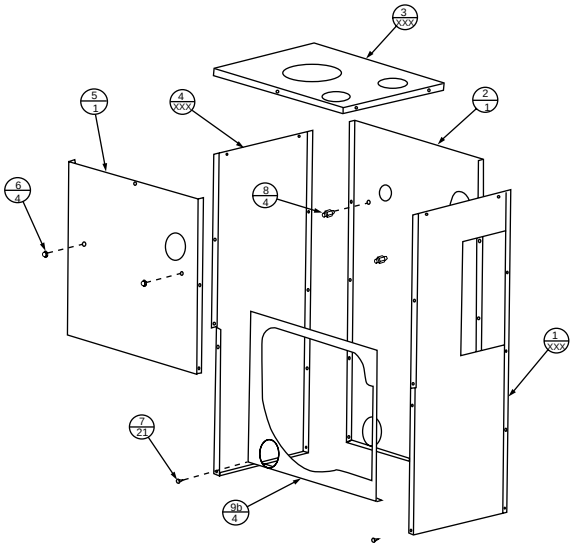
A01040

ITEM	DESCRIPTION	PART NUMBER
1	Section Machined Front	403–00–006
2	Stud TFL (Threaded Full Length) 3/8–16-in. X 2–1/4-in.	146–95–125
3	Whizlok Nut ZP (Zinc Plated) 3/8	146–95–126
4	Insulation Swing Door (Gemoclite Vacuum Formed Ceramic Fiber 2300°)	146–14–014
5	Hinge Machined	403–00–010
6	Rivet RD (Round) HD (Head) Seperated Flange ZP 3/8-in. X 1-in.	146–95–121
7	Bolt Hex (head) Separated Flange ZP (Zinc Plated) 1/4-in. X 2-in.	146–95–124
8	Cut Rope FiberFrax Round Braid 3/8-in. X 48-in.	433–00–905
9	Fire Door Wing Machined	403–00–009
10	Observation Door Machined	403–00–014
11	Washer Lock Plain 5/16-in.	146–95–123
12	Bolt 5/16-in. X 3/8-in. Socket SH (Shoulder) BLT (Bolt) 1/4-in. 20 TH (Thread)	146–95–122

→ **Fig. 21—Swing Fire Door Assembly**

→ **Table 10—Oil Burner Service Parts**

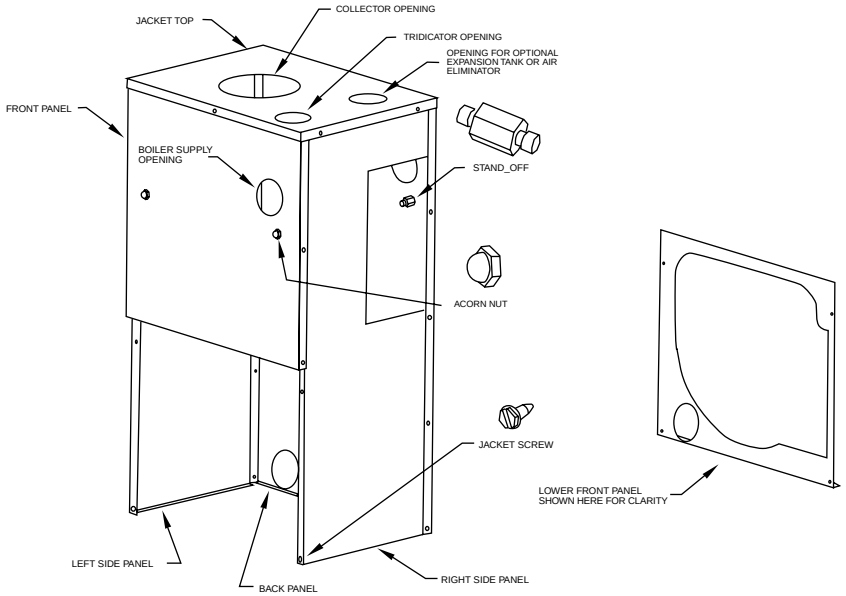
OIL BURNER REPAIR PARTS-BURNER NOT SHOWN	PART NUMBER
Burner Motor	RP-015.00
Fuel Pump	RP04501
Oil Solenoid Valve	RP04601
Ignitor or Ignition Transformer	RP02001
Oil Primary Control 7184B	RY00701
Electrodes for V1 Head (5 section only)	146–19–105
Electrodes for F Head (3 and 4 section only)	146–19–104
Oil Burner Head, F-0	1050003
Oil Burner Head, F-3	1050002
Oil Burner Head, F-6	1050004
Oil Burner Head, V-1	Not Stocked-Order from Beckett
Burner Mounting Gasket	14619106
Cad Cell	14662085
Oil Burner, 3 section	146-19-355
Oil Burner, 4 section	146-19-356
Oil Burner, 5 section	146-19-357



A01042

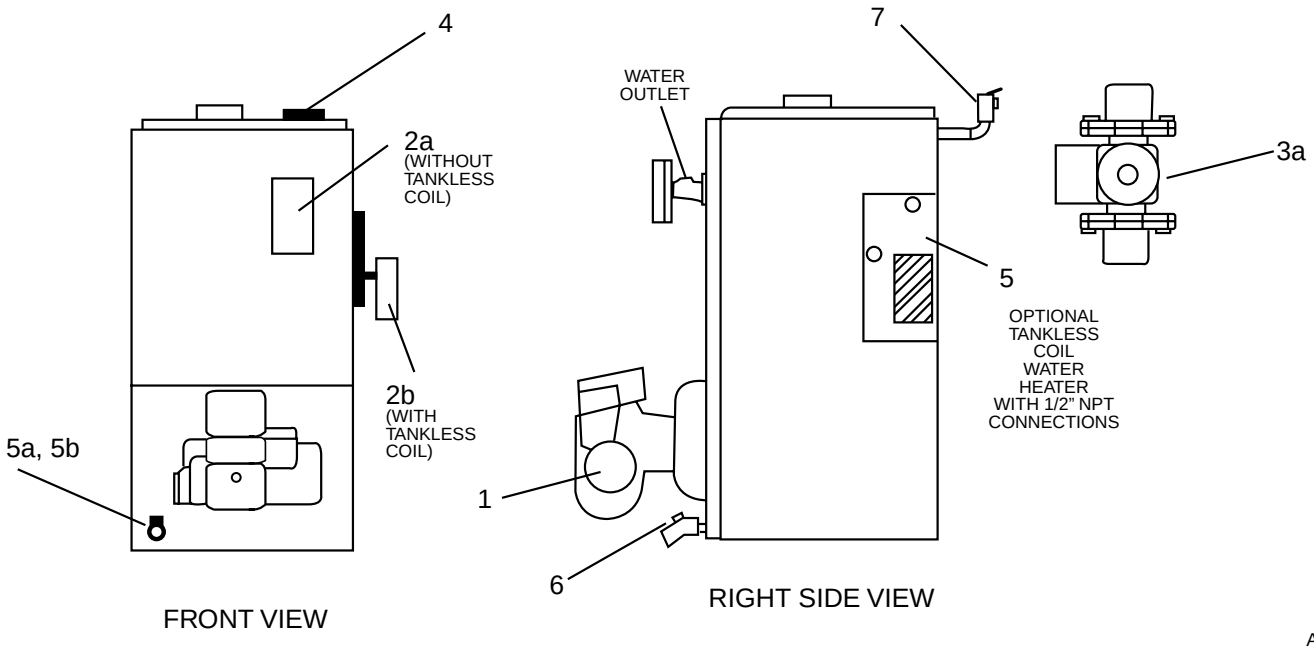
ITEM	DESCRIPTION	3 SECTION	4 SECTION	5 SECTION
1	Right Side Jacket Panel	425–00–244	425–00–245	425–00–246
2	Back Jacket Panel	425–00–269	425–00–269	425–00–269
3	Top Jacket Panel	425–00–254	425–00–255	425–00–256
4	Left Side Jacket Panel	425–00–264	425–00–265	425–00–266
5	Front Jacket Panel	425–00–267	425–00–267	425–00–267
6	5/18-in. Acorn Nut	146–95–042	146–95–042	146–95–042
7	#14 Jacket Screw	146–95–074	146–95–074	146–95–074
8	Stand-Off	146–95–103	146–95–103	146–95–103
9a	Tie Bar (Not Shown)	425–00–268	425–00–268	425–00–268
9b	Lower Front Jacket Panel (Not Shown)	425–00–289	425–00–290	425–00–291

→ **Fig. 22—Exploded Jacket Assembly**



A01041

Fig. 23—Jacket Parts



A02216

ITEM	DESCRIPTION	3EW	4EW	5EW
1	Beckett AFG F-Head oil Burner	146-19-355	146-19-356	____
1	Beckett AFG Variable Head Oil Burner	____	____	146-19-357
____	Beckett AFG F-Head Low Fire Kit (0.65 gph)	433-00-015	____	____
____	Beckett AFG F-Head Low Fire Kit (0.90 gph)	____	433-00-016	____
2a	L8148A-1124 Aquastat Control (no tankless coil)	433-00-521	433-00-521	433-00-521
2b	L8124C-1094 Aquastat Control (with tankless coil)	146-62-022	146-62-022	146-62-022
3a	Taco 007 Circulator	146-26-047	146-26-047	146-26-047
3c	Taco Ciculator Gaskets	146-26-050	146-26-050	146-26-050
____	1-1/4" Flange set with gaskets, nuts, and bolts	146-26-049	146-26-049	146-26-049
____	Taco 007 Circulator with Gaskets	433-00-047	433-00-047	433-00-047
4	Temperature/Pressure Gauge 2" Stem	146-23-003	146-23-003	146-23-003
5a	1-1/4" x 2-1/2" Pipe Nipple	146-07-044	146-07-044	146-07-044
5b	1-1/4" x 3/4" x 1-1/4" Reducing Tee	146-93-049	146-93-049	146-93-049
6	3/4" Drain Valve	146-22-000	146-22-000	146-22-000
7	3/4" Relief Valve	146-22-011	146-22-011	146-22-011
NOTE: Beckett AFG F-Head low fire kits include: static plate, burner head, and oil nozzle. The temperature/pressure gauge connects to the boiler using a 3/4" x 1/4" bushing. The relief valve connects to the boiler using a 3/4" x 2" nipple and a 3/4" street elbow.				

→ **Fig. 24—Repair Parts**